



***PointcutDoctor:  
IDE Support for Understanding and  
Diagnosing AspectJ Pointcuts***

***Lingdong Ye, Kris De Volder***

**University of British Columbia  
Software Practices Lab**





# The Problem **The Solution**

- AspectJ pointcuts are hard to write:
  - global knowledge of the code base is often required
  - AspectJ pointcut and Java language are complex
- The current IDE (e.g. AJDT) lacks support for the above problems

**1) Show almost matched join point shadows**

**2) Provide diagnostic information**

**PointcutDoctor extends AJDT to ...**





# 1. Almost matched join points

Thread Pooling: Capture join points where a thread is created.

```
pointcut threadCreation(Runnable worker)
: call(Thread.new(Runnable)) && args(worker);

Thread around(Runnable worker) : threadCreation(worker) {
    pointcut threadCreation(Runnable worker)
    : call(Thread.new(Runnable)) && args(worker);
    advises
    (→ EchoServer: constructor-call(void java.lang.Thread.<init>(java.lang.Runnable))
```

Is this pointcut correct?

Listing 7.13 - AspectJ in Action : Practical Aspect-Oriented Programming, Ramnivas Laddad.





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Problems Javadoc Declaration Search Error Log Call Hierarchy Cross References

- around(Runnable)
  - advises
    - EchoServer: constructor-call(void java.lang.Thread.<init>(java.lang.Runnable))

- We need to check the code base to ensure there are no unintended misses.
- But current AJDT :
  - only provides a list of matches (hard to notice something that's not in this list)
  - doesn't consider the evolution of the code base.





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Thread Pooling: Capture join points where a thread is created.

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Thread around(Runnable worker) : threadCreation(worker) {
```

Problems Javadoc Declaration Search Error Log Call Hierarchy Cross References

threadCreation(Runnable)

- almost matches
  - (-) ThreadPoolAspect: constructor-call(void DelegatingThread.<init>())
  - (-) (virtual) constructor-call(void Thread.<init>())
  - (-) (virtual) constructor-call(void Thread.<init>(ThreadGroup,Runnable))
  - (-) (virtual) constructor-call(void Thread.<init>(String))
  - (-) (virtual) constructor-call(void Thread.<init>(ThreadGroup,String))
  - (-) (virtual) constructor-call(void Thread.<init>(Runnable,String))
  - (-) (virtual) constructor-call(void Thread.<init>(ThreadGroup,Runnable,String))
  - (-) (virtual) constructor-call(void Thread.<init>(ThreadGroup,Runnable,String,long))
- matches
  - (-) EchoServer: constructor-call(void Thread.<init>(Runnable))

“Almost Matched Join Point Shadows”

“Virtual Join Point Shadows”

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Listing 7.13 - AspectJ in Action : Practical Aspect-Oriented Programming, Ramnivas Laddad.





## 2. Diagnostic information

```
pointcut bulletCreation(Game game, Bullet bullet):  
    call(Bullet.new(Game, double, double, double, double))  
        &&args(game)  
        &&target(bullet)  
        &&!withincode(* *.test*(..));
```

pointcut bulletCreation(Game game, Bullet bullet):  
 call(Bullet.new(Game, double, double, double, double))  
 &&args(game)  
 &&target(bullet)  
 &&!withincode(\* \*.test\*(..));

What about this pointcut?





## 2. Diagnostic information

```
pointcut bulletCreation(Game game, Bullet bullet):
    call(Bullet.new(Game, double, double, double, double))
    &&args(game)
    &&target(bullet)
    &&!withincode(* *.test*(..));

advice defined in spacewar.SoundEffect has not been applied [Xlint:adviceDidNotMatch]
    if (bullet instanceof Missile) playSound("missileFired");
    else playSound("bulletFired");
}
```

Problems Javadoc Declaration Search Error Log Call Hierarchy Cross References &

after(Game, Bullet)

AJDT

Why doesn't it match anything?







## 2. Diagnostic information

```
pointcut bulletCreation(Game game, Bullet bullet):
    call(Bullet.new(Game, double, double, double, double))
    &&args(game)
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    &&!withincode(* *.test*(..));

advice defined in spacewar.SoundEffect has not been applied [Xlint:adviceDidNotMatch]
    if (bullet instanceof Missile) playSound("missileFired");
    else playSound("bulletFired");
}
```

Problems Javadoc Declaration Search Error Log Call Hierarchy Cross References &

..... ↪ after(Game, Bullet)

AJDT





## 2. Diagnostic information

```
pointcut bulletCreation(Game game, Bullet bullet):
    call(Bullet.new(Game, double, double, double, double))
    &&args (game)
    &&target (bullet)
    &&!withincode(* *.test*(..));

after(Game game, Bullet bullet):bulletCreation(game, bullet) {
    if (bullet instanceof Missile) playSound("missileFired");
    else playSound("bulletFired");
}
```

Problems Javadoc Declaration Progress Cross References

- bulletCreation(Game, Bullet)
  - almost matches
    - BigShip: constructor-call(void Missile.<init>(Game,double,double,double,double))
    - Ship: constructor-call(void Bullet.<init>(Game,double,double,double,double))
    - SpaceObjectTest: constructor-call(void Bullet.<init>(Game,double,double,double,double))
    - (virtual) constructor-call(void Bullet.<init>(double,double,Game))
  - matches

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## 2. Diagnostic information

```
pointcut bulletCreation(Game game, Bullet bullet):
    call(Bullet.new(Game, double, double, double, double))
    &&args(game)
    &&target(bullet)
    &&!withincode(* *.test*(..));

after(Game game, Bullet bullet):bulletCreation(game, bullet) {
    if (bullet instanceof Missile) playSound("missileFired");
    else playSound("bulletFired");
}
```

Problems Javadoc Declaration Progress **Cross References** x

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    - BigShip: constructor-call(void Missile.<init>(Game,double,double,double,double))
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## 2. Diagnostic information

```
pointcut bulletCreation(Game game, Bullet bullet):
    call(Bullet.new(Game, double, double, double, double))
    &&args(game)
    &&target(bullet)
    &&!withincode(* *.test*(..));

after(Game game, Bullet bullet):bulletCreation(game, bullet) {
    if (bullet instanceof Missile) playSound("missileFired");
    else playSound("bulletFired");
}
```

Problems Javadoc Declaration Progress **Cross References** x

- bulletCreation(Game, Bullet)
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    - BigShip: constructor-call(void Missile.<init>(Game,double,double,double,double))
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    - (virtual) constructor-call(void Bullet.<init>(double,double,Game))
  - matches

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## 2. Diagnostic information

Highlighting  
Explanation

```
pointcut bulletCreation(Game game, Bullet bullet):  
    call(Bullet.new(Game, double, double, double, double))  
        &&args(game)  
        &&target(bullet)  
        &&!within
```

Mouse-hover  
Explanation

Constructor calls don't have "target". Use the advice after(...) returning (...) to capture the object being created.

```
after(Game game, Bullet bullet, bulletCreation(Game, Bullet)):  
    if (bullet instanceof Missile) playSound("missileFired");  
    else playSound("bulletFired");  
}
```

Problems Javadoc Declaration Progress **Cross References** x

- bulletCreation(Game, Bullet)
  - almost matches
    - BigShip: constructor-call(void Missile.<init>(Game,double,double,double,double))
    - Ship: constructor-call(void Bullet.<init>(Game,double,double,double,double))
    - SpaceObjectTest: constructor-call(void Bullet.<init>(Game,double,double,double,double))**
    - (virtual) constructor-call(void Bullet.<init>(double,double,Game))
  - matches

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# Live Demo: Adding sound effect for spacewar





# Conclusion

- PointcutDoctor explains a pointcut by providing answers for:
  - Which join points does/will (doesn't/won't) it match?
  - Why a join point is (not) matched and how to include a join point?
- PointcutDoctor helps users to
  - ascertain whether a given pointcut is correct
  - diagnose and correct problems
  - learn the pointcut language on the fly



# Thank you!



Project Web Page:

<http://www.cs.ubc.ca/labs/spl/projects/pointcutdoctor/>

Contacts:

Kris De Volder: [kdvolder@cs.ubc.ca](mailto:kdvolder@cs.ubc.ca)

Lingdong Ye: [lintonye@gmail.com](mailto:lintonye@gmail.com)

[lintonye@cs.ubc.ca](mailto:lintonye@cs.ubc.ca)

